

# Chronicling the climate of 2023



**Nature Reviews Earth & Environment launches a new series of articles — Climate Chronicles — that document the characteristics and changes of select climate variables each year.**

**Y**ear on year, consistently worrying reports of unprecedented climate change emerge, highlighting the ongoing – and accelerating – impact of anthropogenic emissions on the climate. 2023 was no exception. In fact, annual, seasonal, monthly and daily temperatures were all the **warmest on record** at various times in 2023: annual mean temperature reached  $-1.46\text{ }^{\circ}\text{C}$  above pre-industrial (1850–1900) levels; seasonal mean temperature during boreal summer was  $>0.3\text{ }^{\circ}\text{C}$  above the previous high; monthly mean temperatures were  $>-0.2\text{ }^{\circ}\text{C}$  above previous highs in all months of June–December; and daily temperatures on the 17th and 18th November were  $2\text{ }^{\circ}\text{C}$  above pre-industrial levels – the first time that threshold has been crossed.

These astonishing temperatures trigger corresponding changes in other components of the interconnected climate system. In a newly launched [Series](#), *Climate Chronicles*, *Nature Reviews Earth & Environment* documents the observed characteristics and changes of several essential climate variables and related topics over 2023. As with temperature, underscoring these articles is a consistent and worrying message – 2023 was unprecedented, with records broken with disturbing frequency and magnitude.

In keeping with the warmest year on record, **exceptional and often prolonged heatwaves** occurred across the globe. Some parts of South America, for example, experienced  $>150$  total heatwave days in 2023, including Brazil's hottest and most widespread heatwave ever recorded in November. Extreme heat also scorched Mexico and the south-western United States in July, such that all days of the month were  $>43\text{ }^{\circ}\text{C}$  in Phoenix, AZ, shattering the previous record by 13 days. **Vegetation greenness** and **terrestrial water storage** also generally reflect these patterns of extreme heat via drought and corresponding land-atmosphere interactions. Negative annual terrestrial water storage anomalies of  $-10$ – $20$  cm were observed throughout several locations in Mexico, the south-western US and South America, as were coherent vegetation browning signatures, often the brownest on record. Warm temperatures and drought further facilitated a **severe wildfire season** that burnt 384 Mha of land globally – the worst since 2017. Notably, Canada witnessed its most extreme fire season in modern history, collectively burning 15.5 Mha and explaining observed browning signatures. Enhanced atmospheric moisture content associated with rising temperatures also likely contributed to several **extreme rainfall events**, including: record-breaking hourly precipitation



in Hong Kong in September (158.1 mm); and record daily precipitation in Myanmar in May (218 mm in some towns) and in Japan in September (391.5 mm).

Marked changes were also observed in the ocean. For instance, full depth ocean heat content reached an **all-time high in 2023**, representing a total accumulation of 464 ZJ heat since 1960. These warmer ocean temperatures also contributed to **reduced sea ice**. In the Arctic, the summer (September) sea ice extent (SIE) minimum reached 4.37 million  $\text{km}^2$ , the 5th lowest since 1979. By contrast, many records were broken in the Antarctic: annual mean, summer (February) minimum and winter (September) maximum SIE were all the lowest on record, reaching 9.81 million  $\text{km}^2$ , 1.91 million  $\text{km}^2$  and 16.80 million  $\text{km}^2$ , respectively.

Of course, natural variability is well known to drive interannual changes in the climate system, contributing to specific records in 2023. Yet, in many instances, these observations are not an irregular occurrence, but rather part of an ongoing longer-term trend, as evidenced for many variables in this Series. Thus, 2023 might not act as a direct harbinger of what is to come, but a warning of larger and more worrying changes on the horizon.

But there might be glimmers of light amidst the darkness. For instance, the global greening trend continued in 2023, reaching the **third highest levels** (after 2020 and 2021) and signalling an enhanced terrestrial carbon sink that offsets some anthropogenic emissions. In particular, many locations within equatorial Africa were the greenest

---

on record, linked to enhanced precipitation and corresponding [positive terrestrial water storage anomalies](#). Global carbon emissions from fossil fuel combustion and cement production also [increased only 0.1%](#) on 2022 values, hinting at a peaking, or at a least plateauing, of emissions growth. Moreover, emissions from the United States and the European Union decreased 2.4% and 6.2% from 2022 levels, respectively. Any ongoing emissions reductions rely on [national and international climate policy](#), of which there were some positive developments in 2023. For instance, the Global Renewables and Energy Efficiency Pledge and the Oil and Gas Decarbonization Charter at COP28, and various Just Energy Transition Partnerships all demonstrate commitments to transition

energy systems to cleaner alternatives. However, these (and other) positive actions are often countered by negative (or contradictory) developments elsewhere, challenging emissions reductions necessary to meet the Paris Agreement.

Only time will tell whether emissions will be reduced, whether temperature thresholds will be crossed, and whether 2023 is, indeed, a harbinger of what is to come. *Nature Reviews Earth & Environment* intends to publish these articles every year (perhaps even covering additional climate variables), so stay tuned for [Climate Chronicles 2024](#) and beyond to track ongoing changes and progress.

Published online: 4 April 2024